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Are interventions theory-based? Development of a Theory Coding Scheme

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Abstract

Objective

Interventions are increasingly described as theory-based; however, the basis for this is often not clear. Advancing behavioural science requires a good understanding of how interventions are informed by, and test, theory. This study aims to develop a reliable method for assessing the extent to which behavioural interventions are theory-based.

Design

The reliability, usability, and comprehensiveness of an initial coding scheme were improved in 13 iterative stages on the basis of its application to 29 papers from a systematic review of interventions to promote physical activity and healthy eating.

Results

The final Theory Coding Scheme contained 19 items, each with satisfactory inter-rater reliabilities, coding whether a theory or model was mentioned, how theories were used in intervention design, how intervention evaluations tested theory and the implications of the results for future theory development.

Conclusion

The Theory Coding Scheme is an important methodological innovation, providing a research tool to reliably describe the theoretical base of interventions, inform evidence syntheses within literature reviews and meta-analyses, and stimulate the use of empirical data for theory development.

Key words: Theory, behaviour change, interventions

Introduction

There is growing recognition in the discipline of psychology, and the broader health services research and public health community (Campbell et al., 2000; Craig et al., 2008), that the development and implementation of behaviour change technologies are enhanced by applying theory. Theory provides a common description of what is known within an organising system. Within the behavioural and social sciences, the term "theory" has been defined variously, but definitions tend to share a core set of common ideas, elegantly expressed in the following:

> "A theory presents a systematic way of understanding events or situations. It is a set of concepts, definitions, and propositions that explain or predict these events or situations by illustrating the relationships between variables."
> Glanz and Rimer (2005, p.4).

Applying theory leads both to "a steadily richer and more potent picture of how things work" (Clarke, 1987, p.35) and to the refinement of the theory from which they derived. The problem of research that lacks explicit theory is characterised by Clarke as "pieces of a jigsaw which accumulate in journals ….despite the fact that a *real* jigsaw puzzle can only be made by taking a picture and cutting it up into pieces, not by making pieces and hoping they will form a picture." (p.35)

Explicit use of theory in designing and evaluating interventions has several benefits. First, theory can be used to inform interventions by identifying constructs (key concepts in the theory) that are hypothesised to be causally related to behaviour and are therefore appropriate targets for the intervention. Changing constructs that cause behaviour will, theoretically, lead to behaviour change (Hardeman et al., 2005). Using theory in this way can confer a range of benefits including potentially stronger effects (Albarracin et al., 2005; Downing, Jones, Cook, & Bellis, 2006; Fisher &

Fisher, 2000; Gehrman & Hovell, 2003; Kim, Stanton, Li, Dickersin, & Galbraith, 1997). First, by identifying theoretical constructs to target, theory provides a means for selecting component intervention techniques (Wingood & DiClemente, 1996; Michie, Johnston, Francis, Hardeman, & Eccles, 2008) and for refining or tailoring intervention techniques (Noar, Benac, & Harris, 2007). Second, collecting empirical data within a theoretical framework facilitates the accumulation of evidence of effectiveness across different contexts, populations and behaviours. Third, as well as using theory to inform intervention development, theory-based interventions can aid understanding of why interventions are effective or ineffective, thus facilitating an understanding of mechanisms of change and providing a basis for refining and developing better theory (Jemmott & Jemmott, 2000; Michie & Abraham, 2004). In this way, there is a synergistic cycle of intervention development and evaluation.

Despite the apparent advantages of applying theory to interventions, a substantial proportion of studies, identified in reviews, fails to make explicit reference to theory, let alone explicitly apply or test it (see Albarracin et al, 2005; Trifiletti, Gielen, Sleet, & Hopkins 2005; Noar & Zimmerman, 2005; Dombrowski, Sniehotta, & Avenell, 2007). Studies are traditionally less likely to be developed within an organising conceptual framework in the behavioural and social sciences than in the biomedical and physical sciences (Clarke, 1987). Theory is too often used as a 'loose framework', to which passing reference is made, rather than as an integral part of a rigorous scientific process. Where a theoretical base for an intervention is stated, there is seldom reference to a method describing how the theory informed the design of the intervention, or how the evaluation tests theory (Rothman, 2004). This may reflect a lack of consideration as to how theory might be used to inform and evaluate the intervention at the planning stage, or poor articulation of these issues at the

dissemination stage. Where theoretically informed interventions have been developed and thoroughly tested, there has been limited consideration of the implications of the findings for theory revision or development (Michie, Sheeran, & Rothman, 2007).

Current practice in systematic reviews of behavioural interventions is to deem an intervention to be theory-based if authors cite theory-based literature in relation to the intervention. Examples of such reviews in the area of prevention of sexually transmitted infections are Albarracin et al. (2005), Downing et al. (2006), Fisher & Fisher (2000), Jemmott & Jemmott (2000), Kim et al. (1997) and Wingood & DiClemente (1996) and, in the area of smoking, Gehrman & Hovell (2003). Other reviews that cross several behavioural domains are Baban & Craciun (2007) and Webb & Sheeran (2006). Many of these reviews claim that interventions grounded in theories of behaviour change were more effective. However, most of these claims are not backed by strong evidence, and few authors who cite theory as the basis for their interventions explain the method by which this is done.

Frameworks have been developed for designing and evaluating complex interventions that give theory a central role within the process e.g. UK Medical Research Council´s framework (Campbell et al., 2000; Craig et al., 2008) and Intervention Mapping (Bartholomew, Parcel, Kok, & Gottlieb, 2006). However, they do not give detailed guidance as to **how** to use theory to design interventions, nor how to use evaluations of behaviour change interventions to test and develop theory (Michie, Sheeran, & Rothman, 2007). If we are to improve our understanding of how interventions effect change, to develop more effective interventions and to use empirical evaluation to develop theory, we need to develop a more precise and scientific method for linking behaviour change theory to designing and evaluating interventions to change behaviour. We need a common understanding of what

"theory-based" means and a rigorous method for assessing the theoretical base for interventions.

This paper reports the development of a detailed, objective and reliable method for assessing the extent to which behavioural interventions are theory-based, specifically the degree to which intervention development and evaluation are informed by, and therefore can inform, behaviour change theory.

Method

Conceptualisation

The starting point for the coding frame came from Ellis et al. (2003) who posited that theory-based interventions require the following; named 'modifying factors', explanations as to how these factors will bring about change, methods to demonstrate changes in the modifying factors, and demonstration of how those changes contributed to behaviour change. We operationalised these concepts as three categories: whether the relevant theoretical constructs ('modifying factors') were targeted by intervention techniques, whether these constructs were measured and whether mediation effects were tested.

Initial development

An initial coding scheme of 10 items was generated, with two to six response options per item: (1) theory specified in introduction to journal article (2) psychological constructs specified in the introduction (3) intervention was generally theory informed (4) intervention focused on either one or more than one specific theory (5) explicit description of how theory-based interventions targeted psychological constructs (6) all theoretical constructs were measured (7) at least one theoretical construct was measured (8) change in any/all theoretical constructs was measured (9) mediation of any/all theoretical constructs was measured (10) findings were

explained in relation to theory, or theories, on which the intervention was based. These 10 items reflected the three categories outlined in the conceptualisation section above. Specifically, items 1-5 related to whether the relevant theoretical constructs were targeted by intervention techniques, item 6-7 related to whether theoretical constructs were measured and items 8-10 referred to whether mediation effects were tested and how the intervention brought about behaviour change.

The initial coding scheme[1] was applied by one of the authors to 29 papers of a systematic review of interventions to increase healthy eating in the general population (Michie, Abraham, Whittington, & McAteer, 2007). A sub-set of papers was coded by the other author. Following discussions between the coders, some items were re-worded and the response options were simplified to either yes/no or all/some/none. Definitions of theory (or model), theory-relevant construct, predictor and intervention technique were then generated.

Refinement

The initial scheme was tested by four independent raters in a series of 13 iterative stages coding papers from a systematic review of interventions to increase healthy eating in the general population (Michie, Abraham, Whittington, & McAteer, 2007). Ten of these stages involved two raters, one involved three and two involved one. The scheme was refined on the basis of discussion between the authors concerning comprehensiveness, clarity and ease of use, feedback from independent raters, and the inter-rater reliability of each item. The final modification was made following the comments of an anonymous reviewer, revising items 12 and 15 and adding items 13 and 19. Inter-rater reliability of two independent coders was assessed using Cohen's kappa statistic. A Cohen's kappa value between .61 and .80 reflects substantial agreement (Landis & Koch, 1977). An overview of the 13 iterative stages is provided in Table 1.

Insert Table 1 here

A glossary of key terms was first introduced at stage 6. The final definitions used as a guide for coders were:

Theory (or Model): 'a set of interrelated concepts, definitions and propositions that present a *systematic* view of events or situations by specifying relations among variables, in order to *explain* or *predict* the events or situations' (Glanz and Rimer, 2005, p.4). Examples provided in the guidance include: Theory of Planned Behaviour, Theory of Reasoned Action, Health Belief Model and Stages of Change/Trans-Theoretical Model.

Theory-relevant construct: A construct (a key concept, excluding behaviour) within a theory/model upon which the intervention is based. A 'Table of Theories' was included in the coding guidance to assist coders in identifying whether a particular construct belongs to the specified theory.

Predictor: A construct that is not explicitly linked to a theory by the authors, but is targeted for intervention (as a means to change behaviour) because it predicts behaviour. Predictors were only coded if the author had presented evidence that the construct predicts/correlates with/causes behaviour. Predictors did not include actual behaviour, self-reported or otherwise (e.g. amount of time spent exercising), or biological factors (e.g., age, gender), or demographic factors (e.g. socio-economic status).

Intervention Technique: Strategy used to change behaviour, theory-relevant construct or predictor (e.g., providing information on consequences; prompting specific goal setting; prompting barrier identification; modelling the behaviour; planning social support).

Results

The final Theory Coding Scheme comprised 19 items with a clear description of how to code each item[2]. Each item required a yes/no/don't know response and the coder to identify the supporting evidence. All items showed substantial inter-rater reliability (all $\kappa s \geq .70$) except one sub-item (19d, $\kappa = .64$) which had a lower, but acceptable kappa and a high level of agreement between coders (18/19, 95%). The scheme and kappa values are shown in Table 2. The items are presented within the following six categories of coded items: reference to underpinning theory (items 1 to 3), targeting of relevant theoretical constructs (items 2, 5, 7-11), using theory to select recipients or tailor interventions (items 4 and 6), measurement of constructs (items 12 and 13), testing of mediation effects (items 14-18) and refining theory (item 19).

Category 1: Is theory mentioned?

These items assessed stated or suggested, rather than demonstrated, theoretical base. One item assessed whether theory was mentioned even if the intervention was not explicitly based on it (item 1). A second item related to whether predictors of the targeted behaviour (item 2) were mentioned (and also targeted) while a third (item 3) assessed whether the intervention was based on a single or multiple theories. An intervention based on a number of different theories or a combination of theory and 'predictors' makes the links between theory and the intervention more complex and, usually, obscure. This makes theory testing more difficult. Often studies use a wide variety of behaviour change techniques in the hope that it will change *something* but this something is often unspecified and not linked to the theory upon which the intervention is stated to have been based.

Category 2: Are the relevant theoretical constructs targeted?

Whether evidence was provided that a targeted theoretical construct predicted behaviour was assessed by item 2 and whether theory or predictors were explicitly used for designing the intervention was assessed by item 5. Items 7-11 examine the extent to which the intervention targets particular theory-relevant constructs. Items 7 and 10 reflect the optimal options as each intervention technique is associated with a specific theoretical construct, clarifying the theoretical basis for each behaviour change technique (item 7) or each theoretical construct is associated with a specific technique, facilitating theory testing (item 10). Items 8, 9 and 11 refer to different, less optimal, ways of mapping (i.e. not one-to-one) between intervention techniques and theoretical constructs/predictors.

Category 3: Is theory to select recipients or tailor interventions

Theory may also be used to select participants likely to benefit from the intervention (item 4) or to tailor the intervention to the needs of a particular individual (item 6).

Category 4: Are the relevant theoretical constructs measured?

Item 12 assesses whether the relevant theory-based constructs/predictors have been measured. Item 13 assesses the reliability and validity of measures of relevant constructs/ predictors and of behaviour, as high measurement quality permits more powerful application, testing and refinement of theory.

Category 5: Is theory tested?

While items 1-11 concern the extent to which interventions have been based on theory, items 12-18 concern theory testing. Items 12-14 assess either whether theoretical constructs are measured adequately pre- and post-intervention, or whether post-intervention measures are accompanied by satisfactory randomisation procedures. Item 15 assesses whether the intervention changes the targeted theoretical

constructs and items 16-18 assess whether these changes explain the effect. Item 16 assesses whether constructs have been demonstrated to mediate the effect of the intervention on behaviour and items 17 and 18 assess whether results are discussed in relation to theory and whether support or refutation of the theory is appropriate, given the results.

Category 6: Is theory refined?

Item 19 assesses whether the results of evaluating theory-based interventions are used to refine theory.

Overview of Final Scheme

The conceptual underpinnings of Items 7-11 are shown in Figure 1, and a diagrammatic representation of the coding scheme is shown in Figure 2. It assesses whether theory is mentioned (1, 3), how theory can *directly* inform an intervention (2, 5, 7-11), how theory can influence an intervention *indirectly* via the selection of participants (4) and via delivery to different groups of participants (6), how theory explains the effects of the intervention on outcomes (12-16), the association between outcomes and theory (17-18) and whether theory is refined on the basis of the study outcomes (19)

Insert Figures 1 & 2 here

Discussion

We have developed a reliable method for assessing the extent to which theory has been applied to developing and evaluating interventions to change behaviour. The Theory Coding Scheme comprises 19 items covering a broad range of areas in which theory can play a role in psychological research. The scale was developed through 13

phases to improve the comprehensiveness, usability, clarity and reliability of the method.

The Theory Coding Scheme has a number of potential benefits and applications. First, it can be used as a measure within reviews and meta-analyses. Specifically, it can provide a means for a more rigorous and systematic examination of the use of theory within intervention research than the approaches adopted in evidence syntheses of intervention effectiveness (e.g., Albarracin et al., 2005; Baban & Craciun, 2007; Trifiletti et al., 2005; Webb & Sheeran, 2006). Typically such reviews ask the question of whether theory-based interventions are more effective than those that are not based on theory. Unfortunately, they consistently fail to consider exactly how theory has informed the intervention. This scheme will allow a more fine-grained examination of whether the use of theory can enhance the effects of interventions and *how* these benefits can be achieved.

Second, it provides a potentially valuable framework for describing interventions, and the role that theory has played, to the scientific community. The CONSORT (Consolidated Standards for Reporting Trials) guidelines have been used to improve the way in which studies, particularly their methodologies, are conveyed to readers. Consequently, the methodological quality of randomized controlled trials (RCTs) can be more reliably considered, potentially helping to reduce heterogeneity in effect sizes across similar studies. The Theory Coding Scheme might be used in a similar way to encourage researchers to articulate their use of theory with greater clarity and depth. Within intervention evaluations, theory can be tested and ultimately refined only if the use of theory is explicit and well reported. A third use of the scheme is as a framework to inform the design of theory-based interventions. By highlighting ways in which theory can be used to select, apply and test interventions,

the coding frame can encourage more careful consideration of what constitutes theory-based interventions and how they can be most usefully developed and evaluated.

The original CONSORT guidelines (Begg et al, 1996) were built upon earlier guidelines (The Standards of Reporting Trials Group, 1994; Working Group on Recommendations for Reporting of Clinical Trials in the Biomedical Literature, 1994). Similarly, this Theory Coding Scheme represents an initial scheme. Its usefulness will be determined by its application. The items in categories 2 and 5 potentially lend themselves to forming a quantitative scale; the current coding scheme is a starting point for further conceptual and methodological refinement.

The Theory Coding Scheme can also be applied to assessments of the processes through which theory-informed interventions change behaviour. Mediation analyses are often conducted to indirectly assess a proposed causal mechanism of change. Whilst statistical methods of mediation analyses are becoming more powerful and sophisticated e.g. using bootstrapping (Cerin, Taylor, Leslie, & Owen, 2006; Preacher & Hayes, 2004), it should be remembered that finding a statistically significant indirect effect supportive of mediation does not prove causation. One limitation of testing theory by examining mediation is that measuring constructs might, in itself, bring about changes in behaviour (e.g., Morwitz & Fitzsimmons, 2004; Godin, Sheeran, Conner, & Germain, 2008) and thus interfere with the interpretation of effects. In addition, demonstrating mediation statistically does not demonstrate a causal relationship between the mediator and the dependent measure; a better approach is to experimentally manipulate the proposed mediator, guided by the theory under test (Sigall & Mills, 1998). Thus, mediation should not be claimed

without appropriate tests, and the possibility of alternative causal explanations should be considered.

A further issue in theory development is what constitutes sufficient evidence to refute a theory. In biological sciences, a rule of thumb is that support or refutation requires independent replication in three independent laboratories. In the behavioural sciences, this is more likely to be seen in laboratory than in applied settings. For example, within the implementation intention (Gollwitzer, 1993) literature, tests of mechanisms are almost exclusively laboratory-based (see Gollwitzer & Sheeran, 2006, for a review of mechanisms). It cannot be assumed that mechanisms demonstrated in laboratories operate in more applied settings. Addressing these, and other questions concerning the application of theory to interventions, will be helped by a systematic method of assessing the way in which theory has been applied. This coding scheme is one method; such methods are foundational for developing this area of behavioural science.

References

Albarracin, D., Gillette, J. C., Earl, A. N., Glasman, L. R., Durantini, M. R., & Ho, M. H. (2005). A test of major assumptions about behavior change: a comprehensive look at the effects of passive and active HIV-prevention interventions since the beginning of the epidemic. *Psychological Bulletin, 131,* 856- 897.

Baban, A., & Craciun, C. (2007). Changing health-risk behaviors: A review of theory and evidence-based interventions in health psychology. *Journal of Cognitive and Behavioral Psychotherapies*, *7*, 45-67.

Bartholomew, L. K., Parcel, G. S., Kok, G., & Gottlieb, N. H. (2006). *Planning health promotion programs; an Intervention Mapping approach.* San Francisco, CA: Jossey-*B*ass.

Begg C., Cho, M., Eastwood, S., Horton, R., Moher, D., Olkin, I., Pitkin, R., Rennie, D., Schulz, K. F., Simel, D., & Stroup, D. F. (1996). Improving the quality of reporting of randomized controlled trials. The CONSORT statement, *Journal of the American Medical Association*, *276*, 637-9.

Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A.L., Sandercock, P. Spiegelhalter, D., & Tyrer, P. (2000). Framework for design and evaluation of complex interventions to improve health. *British Medical Journal, 321,* 694-696.

Cerin, E., Taylor, L. M., Leslie, E., & Owen, N. (2006). Small-scale

randomized controlled trials need more powerful methods of meditational analyses than the Baron-Kenny method. *Journal of Clinical Epidemiology*, *59*, 457-464.

Clarke, D. D. (1987). Fundamental problems with fundamental research: A meta--theory for social psychology. *Philosophica*, *40*, 23-61.

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research council guidance. *British Medical Journal, 337*.

Dombrowski, S. U., Sniehotta, F. F., & Avenell, S. (2007). Towards a cumulative science of behaviour change: Do current conduct and reporting of behavioural interventions fall short of good practice? *Psychology and Health*, *22*, 869-874.

Downing, J., Jones, L., Cook, P. A., & Bellis, M. A. (2006). *Prevention of sexuallytransmitted infections (STIs): a review of reviews into the effectiveness of non clinical interventions. Evidence Briefing Update*. London, UK: National Institute of Clinical Excellence.

Ellis, S., Barnett-Page, E., Morgan, A., Taylor, L., Walters, R., & Goodrich, J. (2003). *HIV prevention: a review of reviews assessing the effectiveness of interventions to reduce the risk of sexual transmission*. London, UK: Health Development Agency.

Fisher, J. D., & Fisher, W. A. (2000). *Theoretical approaches to individual levelchange in HIV risk behaviour*. In Handbook of HIV prevention, Perterson and DiClemente. Kluwer Academic/Plenum Publishers, New York.

Gehrman, C. A., & Hovell, M. F. (2003). Protecting children from environmental tobacco smoke (ETS) exposure: A critical review. *Nicotine & Tobacco Research, 5,*289-301.

Glanz, K. & Rimer, B.K. (2005). *Theory at a Glance: A Guide for Health Promotion Practice* (Second edition). National Cancer Institute, NIH, Public Health Service. U.S. Government Printing Office.

Godin, G., Sheeran, P., Conner, M., Germain, M. (2008). Asking questions changes behaviour: mere measurement effects on frequency of blood donation. *Health Psychology, 27*, 179-84.

Gollwitzer, P. M. (1993). Goal achievement: The role of intentions. In W. Stroebe and M. Hewstone (Eds.), *European Review of Social Psychology, 4*, 141-185. Chichester, England: Wiley.

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances in Experimental Social Psychology*, *38*, 249-268.

Hardeman, W., Sutton, S., Griffin, S., Johnston, M., White, A., Wareham, N., &

Kinmonth, A. L. (2005). A causal modelling approach to the development of theory based behavior change programmes for trial evaluation. *Health Education Research, 20,* 676-687.

Jemmott, J. B., & Jemmott, L. S. (2000). HIV risk reduction behavioral Interventions with heterosexual adolescents. *AIDS, 14 (suppl 2),* S40-S52.

Kim, N., Stanton, B., Li, X., Dickersin, K., & Galbraith, J. (1997). Effectiveness of the 40 adolescent AIDS-risk reduction interventions: A quantitative review. *Journalof Adolescent Health, 20,* 204-215.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, *33*, 159-174.

Michie, S. & Abraham, C. (2004). Identifying techniques that promote health behaviour change: Evidence based or evidence inspired? *Psychology and Health. 19*, 29-49.

Michie, S., Abraham, C., Whittington, C., & McAteer, J. (2007). The impact and mechanisms of self-regulation interventions to increase healthy eating and physical activity. *Psychology and Health*, *22*, *Suppl 1,* 258.

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: mapping theoretically derived behavioural determinants

to behaviour change techniques. *Applied Psychology: an International Review, 57*, 660-680.

Michie, S., Sheeran, P. & Rothman, A. (2007). Advancing the Science of Behaviour Change. Invited editorial, *Psychology and Health, 22,* 249-253.

Morwitz, V. G., & Fitzsimmons, G. J. (2004). The mere-measurement effect: Why does measuring intentions change actual behavior. *Journal of Consumer Psychology*, *14*, 64-73.

Noar, S. M., & Zimmerman, R. S. (2005). Health Behavior Theory and cumulative knowledge regarding health behaviors: are we moving in the right direction? *Health Education Research: Theory and Practice*, *20*, 275-290.

Noar, S. M., Benac, C. N., & Harris, M. S. (2007). Does tailoring matter? Meta-analytic review of tailored print health behaviour change interventions. *Psychological Bulletin, 133*, 673-693.

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behaviour Research Methods, Instruments & Computers*, *36*, 717-731.

Rothman, A. J. (2004). "Is there nothing more practical than a good theory?": Why innovations and advances in health behavior change will arise if interventions are used to test and refine theory. *International Journal of Behavioral Nutrition and Physical Activity, 1, 11*, 1-7.

Sigall, H., & Mills, J. (1998). Measures of independent variables and mediators are useful in social psychology experiments: But are they necessary? *Review of Personality and Social Psychology, 2*, 218-226.

The Standards of Reporting Trials Group (1994). A proposal for structured reporting of randomized controlled trials. The Standards of Reporting Trials Group. *Journal of the American Medical Association, 272*, 1926-31.

Trifiletti, L. B., Gielen, A. C., Sleet, D. A., & Hopkins, K. (2005). Behavioural and social sciences theories and models: are they being used in unintentional injury prevention research? *Health Educational Research, 20,* 298-307.

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of experimental evidence. *Psychological Bulletin*, *132*, 249-268.

Wingwood, G. M., & DiClemente, R. (1996). HIV sexual interventions for women: A review. *American Journal of Preventive Medicine, 12*, 209-217.

Working Group on Recommendations for Reporting of Clinical Trials in the Biomedical Literature (1994). Call for comments on a proposal to improve reporting of clinical trials in the biomedical literature. Working Group on Recommendations for Reporting of Clinical Trials in the Biomedical Literature. *Annals of Internal Medicine*, *121*, 894-5.

Table 1: Overview of Coding Scheme Development

Stage	Basis for development	Development
1	Need for an initial coding scheme.	Scheme 1 (10 items). Up to 6 response options per item. See text ('Initial Development') for further details.
2	Scheme 1 applied to 29 papers by the second author and a sub-set of papers by the first author. Discussion between authors.	Scheme 2 (15 items). Coding response options modified to yes/no/don't know for all items except those relating to measurement of, and change in, theoretical constructs (which were coded as all/some/none). Items added: Theory/constructs used to select recipients for the intervention; Theory/constructs used to tailor intervention techniques to recipients; item 5 from Scheme 1 separated into further items; Support for theory stated with/without appropriate mediation; Results used to refine theory. Concept of targeted predictors is introduced. Some items modified to aid clarity.
3	Scheme 2 tested on 9 papers by both authors.	Scheme 3 (16 items). Item linking techniques to constructs separated into 2 items. Greater emphasis at this stage on the explicit use of theory cited within the paper. The term 'post-intervention' added to the measurement and evaluation items. Theory-relevant construct is defined.
4	Discussion between the authors.	Scheme 4 (19 items). Problematic items omitted/simplified (each item coded as yes/no). The mark scheme is formulated such that there is 1 form for each entry/paper. At this stage, three items (rather than two) reflected techniques-construct mapping. Items added that require coders to list the constructs a) targeted; b) measured; c) change following intervention.
5	Scheme 4 applied to one paper by 1 author.	Scheme 5 (15 items). Items requiring coders to list constructs were merged with relevant items.
6	Scheme 5 applied to one paper by both authors.	Scheme 6 (15 items). Instructions were included for the first time with a glossary of key terms (theory; theory-relevant construct; predictors; intervention techniques). Additional written information is provided for the three items reflecting the mapping of techniques to constructs. Mediation analysis item separated into multiple sub-items.
7	Scheme 6 tested on 2 papers by three raters. Some disagreement on 5 of the 15 items.	Scheme 7 (15 items). Diagrams added for the three items reflecting the mapping of techniques to constructs, definitions of key terms and item order were modified.
8	Scheme 7 tested on 14 papers by two raters.	Scheme 8 (15 items). Items refined according to rater feedback and kappa values.

	Six of the 15 items yielded kappa <.70.	
9	Scheme 8 tested on 15 papers by two raters. Two of the 15 items yielded kappa <.70.	Scheme 9 (15 items). Items refined according to rater feedback and kappa values.
10	Scheme 9 tested on 15 papers by two raters. One of the 15 items yielded kappa <.70.	Scheme 10 (15 items). Item refined according to rater feedback and kappa values.
11	Scheme 10 tested on 22 papers by two raters. All 15 items were reliable.	Scheme 11 (15 items). Although scheme 10 was reliable, three items were modified slightly to aid clarity.
12	Scheme 11 tested on 22 papers by new rater. All 15 items were reliable. Two items concerning construct-technique mapping needed.	Scheme 11b (17 items). Two items (kappa >.80) added reflecting the degree to which constructs are targeted by specific techniques.
13	Scheme 12 tested on 19 papers by two raters.	Scheme 12 (19 items). Items 12 and 14d revised, and items 13 and 14 added following reviewer feedback. All kappas of new items were >= .64.

*Table 2.Overview of Theory Coding Scheme*

Item No. and kappa	Item	Description	Yes/ No/ Don't know	List with location in paper (i.e. page number)	
1 (1)	*Theory/model of behaviour mentioned*	Models/theories that specify relations among variables, in order to *explain* or *predict* behaviour (e.g., TPB, SCT, HBM) are mentioned, even if the intervention is not based on this theory			
2 (.77)	*Targeted construct mentioned as predictor of behaviour*	('Targeted' construct refers to a psychological construct that the study intervention is hypothesised to change). Evidence that the psychological construct relates to (correlates/predicts/causes) behaviour should be presented within the introduction or method (rather than the Discussion).		Location of evidence that construct relates to behaviour: Location that this predictor is targeted by the intervention:	
3 (.70)	*Intervention based on single theory*	The intervention is based on a single theory (rather than a combination of theories or theory + predictors)			
4 (.83)	*Theory/ predictors used to select recipients for the intervention*	Participants were screened/selected based on achieving a particular score/level on a theory-relevant construct/predictor		Construct (Theory)	Predictor
5 (.88)	*Theory/ predictors used to select/develop intervention techniques*	The intervention is explicitly based on a theory or predictor or combination of theories or predictors		Theory	Predictor
6 (.86)	*Theory/ predictors used to tailor intervention techniques to recipients*	The intervention differs for different sub-groups that vary on a psychological construct (e.g., stage of change) or predictor at <u>baseline</u>		Construct	Predictor
7 (1)	*All intervention techniques are explicitly*	Each intervention technique is explicitly linked to at least one theory-relevant construct/predictor.		Construct (list links)	Predictor (list links)

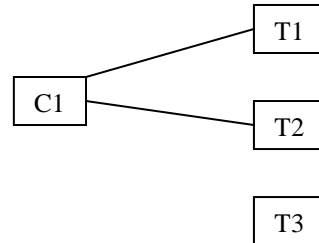|				
	linked to at least one theory-relevant construct/ predictor			
8 **(.91)**	*At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/ predictor*	At least one, but not all, of the intervention techniques are explicitly linked to at least one theory-relevant construct/ predictor.	Construct (list links)	Predictor (list links)
9 **(.74)**	*Group of techniques are linked to a group of constructs/ predictors*	A cluster of techniques is linked to a cluster of constructs/ predictors.	List clusters of techniques/constructs	List clusters of techniques/predictors
10 **(.80)**	*All theory-relevant constructs/predictors are explicitly linked to at least one intervention technique*	Every theoretical construct within a stated theory, or every stated predictor (see item 5), is linked to at least one intervention technique.	Construct (list links)	Predictor (list links)
11 **(.90)**	*At least one, but not all, of the theory relevant constructs/predictors are explicitly linked to at least one intervention technique*	At least one, but not all, of the theoretical constructs within a stated theory or at least one, but not all, of the stated predictors (see item 5) are linked to at least one intervention technique.	Construct (list links)	Predictor (list links)

12 **(1)**	*Theory-relevant constructs/ predictors are measured*	a) At least one construct of theory (or predictor) mentioned in relation to the intervention is measured POST-INTERVENTION. b) At least one construct of theory (or predictor) mentioned in relation to the intervention is measured PRE AND POST-INTERVENTION.	Construct	Predictor
13 **(a=.77)** **(b=.77)** **(c=1)** **(d=.64)** **(e=.89)** **(f=.76)**	*Quality of Measures*	a) All of the measures of theory relevant constructs/predictors had some evidence for their reliability b) At least one, but not all, of the measures of theory relevant constructs/predictors had some evidence for their reliability c) All of the measures of theory relevant constructs/predictors have been previously validated d) At least one, but not all, of the measures of theory relevant constructs/predictors have been previously validated e) The behaviour measure had some evidence for its reliability f) The behaviour measure has been previously validated	Construct	Predictor
14 **(all=1,** **except** **b=.73)**	*Randomization of participants to condition*	a) Do the authors claim randomization? b) Is a method of random allocation to condition described (e.g., random number generator; coin toss) c) Was the success of randomization tested? d) Was the randomization successful (or baseline differences between intervention and control group statistically controlled)?		
15 **(1)**	*Changes in measured theory-relevant*	The intervention leads to sig. change in at least one theory-relevant construct/predictor (vs. control group) in favour of	Construct	Predictor

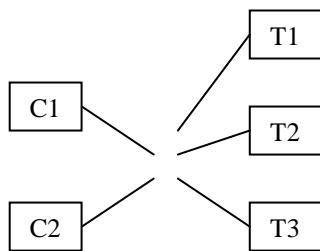|			Construct	Predictor
	constructs/ predictor	the intervention.		
16 **(1 for each sub- item)**	*Mediational analysis of construct/s / predictors*	In addition to 14, do the following effects emerge?: a) Mediator predicts DV? (or change in mediator leads to change in DV) b) Mediator predicts DV (when controlling for IV)? c) Intervention does not predict DV (when controlling for mediator)? d) Mediated effect statistically significant?	Construct	Predictor
17 **(.72)**	*Results discussed in relation to theory*	Results are discussed in terms of the theoretical basis of the intervention		
18 **(.78)**	*Appropriate support for theory*	Support for the theory is based on appropriate mediation OR refutation of the theory is based on obtaining appropriate null effects (i.e. changing behaviour without changing the theory-relevant constructs).		
19 **(1)**	*Results used to refine theory*	The authors attempt to refine the theory upon which the intervention was based by either: a) adding or removing constructs to the theory, or b) specifying that the interrelationships between the theoretical constructs should be changed and spelling out which relationships should be changed	a) Constructs added or removed from theory: b) Interrelationships between the theoretical constructs to be changed:	

Item 7: Example: All intervention techniques (T) are linked to at least one theory-relevant construct/ predictor (C)
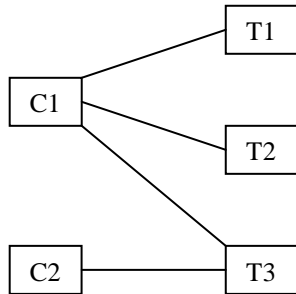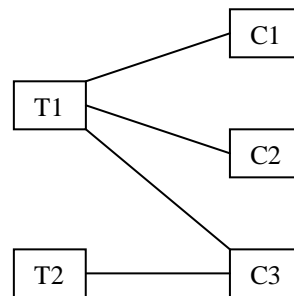
Item 8: Example: At least one, but not all, of the intervention techniques (T) are linked to at least one theory-relevant construct/predictor (C)

Item 9: Example: Group of techniques (T) are linked to a group of theory-relevant constructs/ predictors (C)

Item 10: Example: All constructs within a stated theory/all predictors (C) are linked to at least one intervention technique (T)

Item 11: Example: At least one, but not all, of the constructs within a stated theory/stated predictors (C) are linked to at least one intervention technique (T)
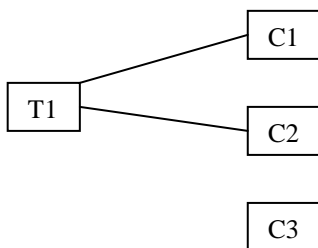
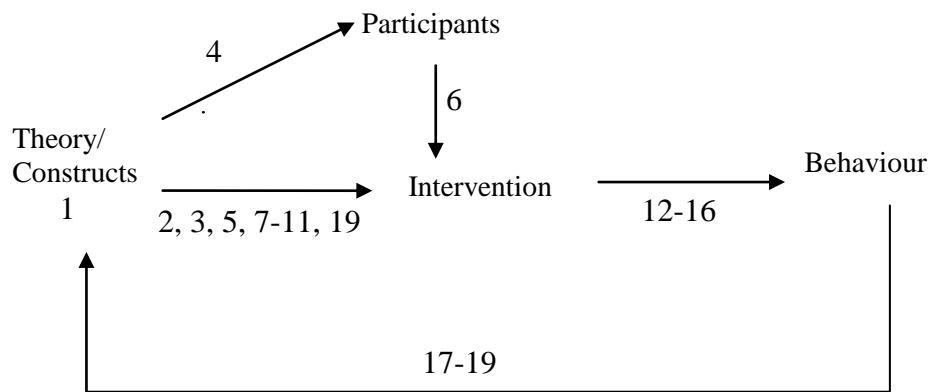*Figure 1. Conceptual underpinnings of the coding scheme (numbers refer to coding scheme items)*

Figure 2. Diagrammatic Representation of Coding Scheme: numbers refer to items

Footnotes

[1] The references for these pre-coded papers, and their associated codes, are available upon request.

[2] Available upon request.